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DUTCH MONETARISM

by F.A.G. den Butter

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Summary

This paper reconsiders dr. Holtrop's regression equation $\Delta Y = f(D, E)$ relating a change in national income (ΔY) to the domestic monetary impulse (D) and the external monetary impulse (E). The regression equation should be regarded as an extension of Holtrop's model, defining the monetary impulses and their components. This interpretation allows us to estimate the influence of the liquidity activation as part of the domestic monetary impulse and in doing so to take account of the simultaneity of the model. In addition, the lag structure of the above equation is investigated by means of transfer function analysis. To that end quarterly data for the monetary impulses are constructed for 1962:I-1976:IV. The fit of Holtrop's equation proves to be poor when data of the 1970s are added to the sample period and the transfer function analysis shows little causal relationship between the monetary impulses and a change in the national income. However, the explanatory power of the St. Louis monetarism when applied to the Netherlands is not much better.

DUTCH MONETARISM

by F.A.G. den Butter^{*}

1. INTRODUCTION

More often than not, new ideas and views in the field of macroeconomics evolve in laboratories somewhat secluded from the practical scene. An exception to this rule is the Netherlands Bank's monetary analysis, whose foundations were laid during Dr. Holtrop's presidency in the nineteen fifties and sixties. This unique method of interpreting monetary phenomena was developed on the very spot where it could be applied directly to shape and support practical policy: the central bank. Consequently, the method is wholly inspired by, and oriented towards, actual practice. In the case of the Netherlands, it means that the method especially reflects the openness of the economy. In an open economy the money stock may be substantially drained or augmented through balance of payments deficits or surpluses.

The roots of Netherlands monetary theory are found in J.G. Koopman's (1933) discourse on the problem of the neutrality of money. Additionally, Holtrop in his analysis took as a basis the views on the cash balance theory as laid down as early as in 1928 in his doctoral thesis on the velocity of the circulation of money. The analysis primarily aims at tracing the sources of monetary disturbances. First, this led to a survey of the causes of changes in the money stock [see Holtrop¹⁾ (1972.1)]. Since 1948 a table listing these causes and their effects holds a prominent place in the Annual Reports of the Netherlands Bank.

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1) Holtrop's principal writings have been collected in "Money in an Open Economy", Leiden, 1972. For Holtrop's articles, reference is made here to this book; the number following the year indicates the article concerned (see the references at the end of this paper).

The table shows a breakdown of the changes in the money stock (for 1948 and 1948 M_1 , later M_2) into liquidity creation on behalf of the public sector, short-term lending to the private sector, the money-creating institutions' net long-term operations and inflow of foreign funds.

The search for the causes of monetary disturbances culminated in a "model", i.e. a set of definition equations used to calculate the "monetary impulses". The formulae of the model were first presented by Holtrop at a round-table conference on inflation, which was held at Helsingor, Denmark, in September 1959 [see Holtrop (1972.2)]. Since 1959 the Netherlands Bank's Annual Reports have included a table listing the monetary impulses; the table shows the domestic and external monetary impulses and their components (inflow of foreign funds, domestic liquidity creation, liquidity absorption and liquidity activation)²⁾.

In a paper read to the Royal Netherlands Academy of Sciences in September 1970 [see Holtrop (1972.3)], Holtrop reported his attempts to measure the effect of the monetary impulses on changes in the national income by means of regression analysis. One of his findings was that in the period 1954-1969 both liquidity creation, as the representative of the domestic impulse, and the external impulse, made an important and significant contribution to the change in the nominal national income.

Holtrop and his assistants did not, of course, develop their monetary analysis in complete isolation from the views of the academic world. On the contrary, when the analysis was being set up, a lively exchange of views was conducted between Holtrop and the economists Koopmans, Tinbergen and Witteveen. This discussion, which was published in Dutch in "Economisch-Statistische Berichten" in 1954 and 1955 evoked extensive critiques by Goedhart (1955) and De Jong (1955), among others, and prompted Kessler (1958) to make his study on monetary equilibrium and balance-of-payments equilibrium. Additionally, a review in English of the dispute between Holtrop and Witteveen is provided by Bos (1965). At a later stage, it was notably De Jong (1967, 1973) who analysed the dimensional aspects of Holtrop's method and thus gave an example of the application of dimensional analysis to the field of economics.

2) Since 1976 the external impulse is no longer included.

The fact that in Holtrop's regression equation it is solely the monetary impulses which are used to "explain" the national income is clear evidence of the monetarist nature of Dutch monetary theory. However, in this case this one-sided interpretation of economic reality is quite deliberate and does not pretend, as some orthodox forms of American monetarism do, to reveal the principal, or even the only and true, causes of changes in the nominal national income (or prices).

Another noteworthy difference between Dutch and American monetarism is as follows. In American monetarism emphasis is placed on the influence of the total money supply, whereas in Holtrop's analysis a clear distinction is made between inflows of liquidity from abroad as a non-controllable part and liquidity creation as a controllable part, of (a change in) the money stock [see Guitian (1977)]. Therefore, Dutch monetary theory may be viewed as a precursor to the monetary approach to the balance of payments [see Johnson (1972)]. In this context it might be noted that in the fifties Polak, at the IMF, designed a method of monetary analysis which bears much resemblance to Holtrop's method [see Polak (1957), Polak and Boissonneault (1969), IMF (1977)].

In this paper I reconsider Holtrop's attempt in 1970 to measure the influence of the monetary impulses on the national income empirically. The paper is set up as follows. Firstly, after the presentation of Holtrop's model in section 2, Holtrop's equation is re-estimated in section 3, using yearly data. Secondly, the liquidity activation, which Holtrop left out of his specification because of simultaneity problems, is included in the equation. In section 4 the estimation results are presented for the liquidity activation computed on the basis of Holtrop's original formula. Additionally, in section 5, two alternative yardsticks for liquidity activation using a demand-for-money function are tried. In the third part of the paper the dynamics of Holtrop's regression equation are tested using quarterly data for the sample period 1962:I - 1976:IV. In section 6 this investigation into the lag structure is done by simply tracing the lags which in terms of R^2 and t-values yield the best fit. Subsequently, in

section 7 the lag structure is inspected by means of transfer functions. In addition to Holtrop's equation, estimates are also made for a St. Louis-type equation, with the change in the money stock and government expenditure as the explanatory variables. The aim, [see e.g. Rutten (1973) and Selden (1975)] is to permit a comparison of the results for the Netherlands of this form of American monetarism with Holtrop's Dutch monetarism. Finally in section 8 some conclusions are given.

This paper is not aiming at a conversion or an extension of Holtrop's monetary analysis into an econometric model with behavioural equations. To that end, the framework provided by the analysis is unsuited. The purpose of this investigation is a modest one: to subject the regression equation presented in the paper read to the Academy of Sciences to further analysis and to deal with some major comments evoked by that paper (concerning the lack of a lag structure, the use of liquidity creation instead of the total money stock, the bad fit when estimating with more recent data). However even within this purpose, this study has its limitations. For instance, the net national income has been used consistently as the traditional income concept, even though it may be argued with reason that the gross national product constitutes at least an equally suitable income concept from both a theoretical and a practical point of view. Additionally, the study only investigates the influence of the monetary impulses on the net national income in nominal terms, while, contrary to Holtrop's analysis, it does not include a break-down of this influence into a price and a volume effect. Finally, it is in line with the philosophy underlying Holtrop's model to take account of simultaneity not only with respect to liquidity activation but also with respect to the external monetary impulse. This should be done by means of an import equation, but for the sake of simplicity it was decided not to include such an equation in this investigation.

2. HOLTROP'S MODEL

Holtrop's model does not aim at explaining movements in major macroeconomic aggregates, such as income and the balance of payments. It merely serves to indicate the monetary conditions attending the movements in the aggregates and to localize any disturbances of a monetary nature. Kessler (1972) therefore calls it a condition model as contrasted to a causal model. It does not incorporate any behavioural equations but consists solely of identities which represent the equilibrium conditions or which can be used to compute the monetary disturbances. This property of the model has caused its presentation, both in Holtrop's original description (1972.2) for the Helsingor conference and in later sources [Holtrop (1972.3), Kessler (1972), De Jong (1973) and Selden (1975)], to differ from the usual form of econometric models. For instance, the model has not been set up in terms of exogenous and endogenous variables and even about the number of equations no explicit information has ever been provided. It must be noted, though, that, in the case of a condition model, it is not of major significance to know which variables are endogenous and which are exogenous. As the equations do not suggest the direction of causality and are merely identities, rewriting the identities is simply reformulating the equilibrium conditions.

Nevertheless, in the following it is tried to present the model from the angle of econometric model building. The starting-point is the table of monetary impulses as given in the Bank's Annual Reports. This table first shows a breakdown of the increase in the domestic money stock (ΔL) into domestic liquidity creation (Lcr) and the national liquidity surplus (B).

$$\Delta L = Lcr + B \quad (1)$$

This equation can be regarded as a money supply equation, in which the national liquidity surplus represents the inflow of funds from abroad.

The second equation concerns liquidity activation ($Lact$):

$$Lact = k\Delta Y + \Delta L - \Delta LBB \quad (2)$$

This liquidity activation, which plays a specific role in Holtrop's model, indicates to what extent holders of liquidity hoard or dishoard of their own accord. This spontaneous increase

or decrease in liquidity preference changes the velocity of the money circulation. The term $k\Delta Y$ represents a normal increase in the money supply on account of a change of ΔY in the nominal national income, with k as the marginal liquidity ratio. In fact, k is taken to be the liquidity ratio at the end of the preceding year, so that

$$k = L_{t-1}/Y_{t-1}$$

The term ΔLBB - the change in liquid funds held abroad by enterprises - has technical significance only and is not found elsewhere in the descriptions of Holtrop's model. It should be noted that ΔLBB is of little quantitative significance.

Liquidity activation, as an autonomous part of the change in the money stock, combines with liquidity creation (Lcr) to form the domestic monetary impulse (D):

$$D = Lcr + Lact \quad (3)$$

If the holders of liquidity wish to hold an above-normal level of liquid assets, part of the liquidity creation serves to meet this demand; that part is not counted as an element of the domestic monetary impulse. In that case, the liquidity activation is negative. On the other hand, the formula shows that if there is spontaneous dishoarding and, hence, an increase in the velocity of circulation of money, such dishoarding is, in addition to liquidity creation, counted as an element of the domestic monetary impulse.

Finally, the external monetary impulse (E):

$$E_t = X_t - M_{t-1} + K_t + \Delta LBB_t$$

Apart from ΔLBB , which is shifted from the domestic to the external impulse, this external impulse is basically equal to the balance-of-payments surplus.

$$B = X - M + K$$

where X is exports of goods and services, M is imports of goods and services and K is the balance on the capital account. However, for imports the preceding year's amount is taken as, roughly speaking, Holtrop regards the change in imports in the current year as a consequence of the change in the national

income: $\Delta M = m\Delta Y$ (where m is the marginal import ratio). This induced change in imports is not considered to form part of the autonomous external monetary impulse. This leads to the following equation for the actual calculation of the external monetary impulse:

$$E = B + \Delta M + \Delta LBB \quad (4)$$

A somewhat arbitrary element in the calculation of the external impulse is the assumption that the change in the national income influences imports for precisely one year. In this regard, Holtrop's monetary analysis differs from Polak's [see Prajs (1961), Holtrop (1972.2)]. Instead of one year, Polak takes the period in which a national income equal to the money stock is generated.

The above 4 equations indicate how the impulses and their components are calculated in the impulse analysis. From this point of view Holtrop's model appears to consist of 4 basic equations with, in the terminology of econometric model building, ΔL , L_{act} , D and E as endogenous variables and L_{cr} , B , M , Y and LBB as given, i.e. exogenous variables. The model is both normalized and recursive.

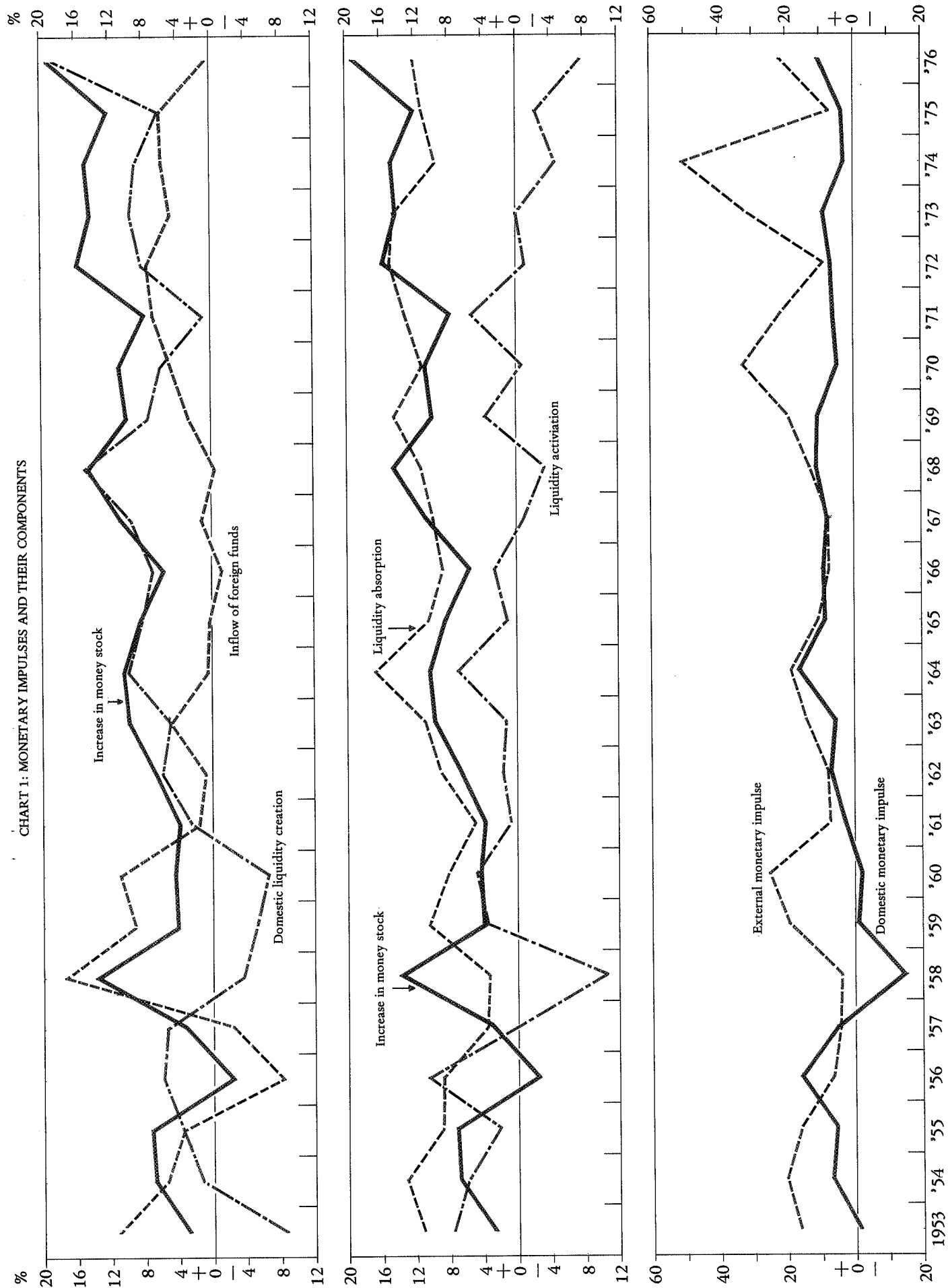
Chart 1 shows the monetary impulses and their components for the 1953-1976 period³⁾. In the upper part of the chart the increase in the domestic money stock is depicted. According to (1) this is the sum of domestic liquidity creation and liquidity inflows from abroad. The middle part of the chart shows how this increase in the money stock is divided into a) liquidity absorption through an increase in the national income and b) liquidity activation. Finally, the bottom part of the figure shows the domestic and the external monetary impulses calculated according to equations (3) and (4). In accordance with usage in the Annual Reports all variables are expressed in percentages of the money stock at the end of the past year, with the exception of liquidity absorption through an increase in the national income, which is defined as $100 \times \Delta Y/Y_{-1}$ ⁴⁾. For the 1972-1976 period, the domestic liquidity creation and the money stock have been corrected for switching, induced by interest

3) For data and sources see Appendix A.

4) $k = L_{-1}/Y_{-1}$ and formula (3) yield

$$\Delta L/L_{-1} = \Delta Y/Y_{-1} - L_{act}/L_{-1} \quad (-\Delta LBB/L_{-1}).$$

CHART 1: MONETARY IMPULSES AND THEIR COMPONENTS



rate changes, between savings accounts and time deposits, [see Fase (1977, 1978)].

The chart clearly shows that, except for 1956, the money stock increased continually and that the domestic liquidity creation and liquidity inflows from abroad alternated in contributing toward this increase. It must be noted that the domestic impulse has undergone a much more smooth development in recent years than the external impulse.

3. RE-ESTIMATION OF HOLTROP'S REGRESSION EQUATION

In order to verify statistically the influence of the monetary impulses on a change in the national income, Holtrop, in his paper read to the Royal Netherlands Academy of Sciences, estimates the following equation:

$$\Delta Y = f(D, E) \quad (5)$$

If we add the formula $\Delta M = m\Delta Y$ to Holtrop's model of the previous section, the model yields

$$\Delta Y = \frac{1}{k+m} (D + E)$$

However, regression equation (5) may not be considered a verification of the above relation [see e.g. Engering (1972)]. Firstly, there is no sense in applying regression analysis where a fixed relation has been postulated by definition and where the explanatory variables have even been calculated in accordance with this relation, albeit in a non-linear way as both k and m vary in time. Secondly, it is obvious from the previous section that from the view-point of econometric model building, which is important now that we use regression analysis, the ΔY is an exogenous variable in Holtrop's model. For this reason, regression equation (5) cannot be viewed as a re-formulation of this model.

Therefore, I regard equation (5) simply as an attempt to measure the influence of the monetary impulses on a change in the national income. Thus equation (5) should be seen as a sort of monetarist reduced form equation such as the St. Louis equation; the underlying behavioural equations are not made explicit. This equation can assess the relevance of the monetary impulses calculated by means of Holtrop's model, indicating to what extent

the national income can be regulated by means of the impulses.

The regression result of (5) presented by Holtrop for his sample period 1954-1969 is [see Holtrop (1972.3, page 232)]:
(t-values in parentheses, \bar{R}^2 adjusted for degrees of freedom)

$$\Delta Y^+ = 2.50 + 0.32 \text{ Lcr}^* + 0.43 \text{ E}^* \quad \bar{R}^2 = 0.64$$

(3.2) (5.4)

$$\text{with } \Delta Y^+ = \Delta Y / Y_{-1} \times 100$$

$$\text{Lcr}^* = \text{Lcr} / L_{-1} \times 100$$

$$\text{E}^* = \text{E} / L_{-1} \times 100$$

We see that Holtrop does not regress ΔY itself with the monetary impulses, but the percentage change in the national income with the impulses expressed as percentages of the total money stock at the end of the past year. This form accords with the presentation of the impulses in the Annual Reports and with chart 1. Apart from the functional form, Holtrop's estimations deviate from specification (5) in yet another aspect: in his regression Holtrop leaves out liquidity activation as a part of the domestic monetary impulse.

Re-estimation of the above regression equation for Holtrop's sample period: 1954-1969 with newly constructed data yields:
(DW: Durbin-Watson test statistic)

$$\Delta Y^+ = 1.98 + 0.40 \text{ Lcr}^* + 0.45 \text{ E}^* \quad \bar{R}^2 = 0.76$$

(1.68) (4.83) (6.30) DW = 2.56

Because of the corrections in the data, the fit slightly improves in comparison to Holtrop's estimations. It appears that in this period both the liquidity creation and the external monetary impulse had a significant influence on the percentage change in the national income. The size of this influence was virtually the same for both impulses.

When more recent observations are included, the result for 1954-1976 is

$$\Delta Y^+ = 7.46 + 0.22 \text{ Lcr}^* + 0.10 \text{ E}^* \quad \bar{R}^2 = 0.21$$

(5.82) (1.96) (1.81) DW = 1.76

and when the first observations are omitted we get for 1962-1976

$$\Delta Y^+ = 11.17 + 0.04 \text{ Lcr}^* + 0.02 \text{ E}^*$$

(6.17) (0.26) (0.35)

$$\bar{R}^2 = -0.15$$

$$\text{DW} = 1.83$$

It is most noteworthy that the fit decreases so strongly when including recent data. The results obtained by Selden (1975), who extended Holtrop's sample period by two years, already pointed in this direction. For the most recent period there appears to be no correlation at all. As mentioned above, the functional form of the above regression equation does not completely fit in with the calculation of the impulses in Holtrop's model. A better alternative is to explain ΔY in terms of the impulses themselves. The outcomes for the three different sample periods are (ΔY and impulses in billions of guilders):

1954-1969

$$\Delta Y = 0.24 + 1.37 \text{ Lcr} + 1.31 \text{ E}$$

(0.55) (7.42) (8.06)

$$\bar{R}^2 = 0.92$$

$$\text{DW} = 2.26$$

1954-1976

$$\Delta Y = 3.81 + 1.43 \text{ Lcr} + 0.34 \text{ E}$$

(3.29) (3.84) (2.05)

$$\bar{R}^2 = 0.66$$

$$\text{DW} = 1.71$$

1962-1976

$$\Delta Y = 6.41 + 1.16 \text{ Lcr} + 0.27 \text{ E}$$

(3.43) (2.50) (1.40)

$$\bar{R}^2 = 0.51$$

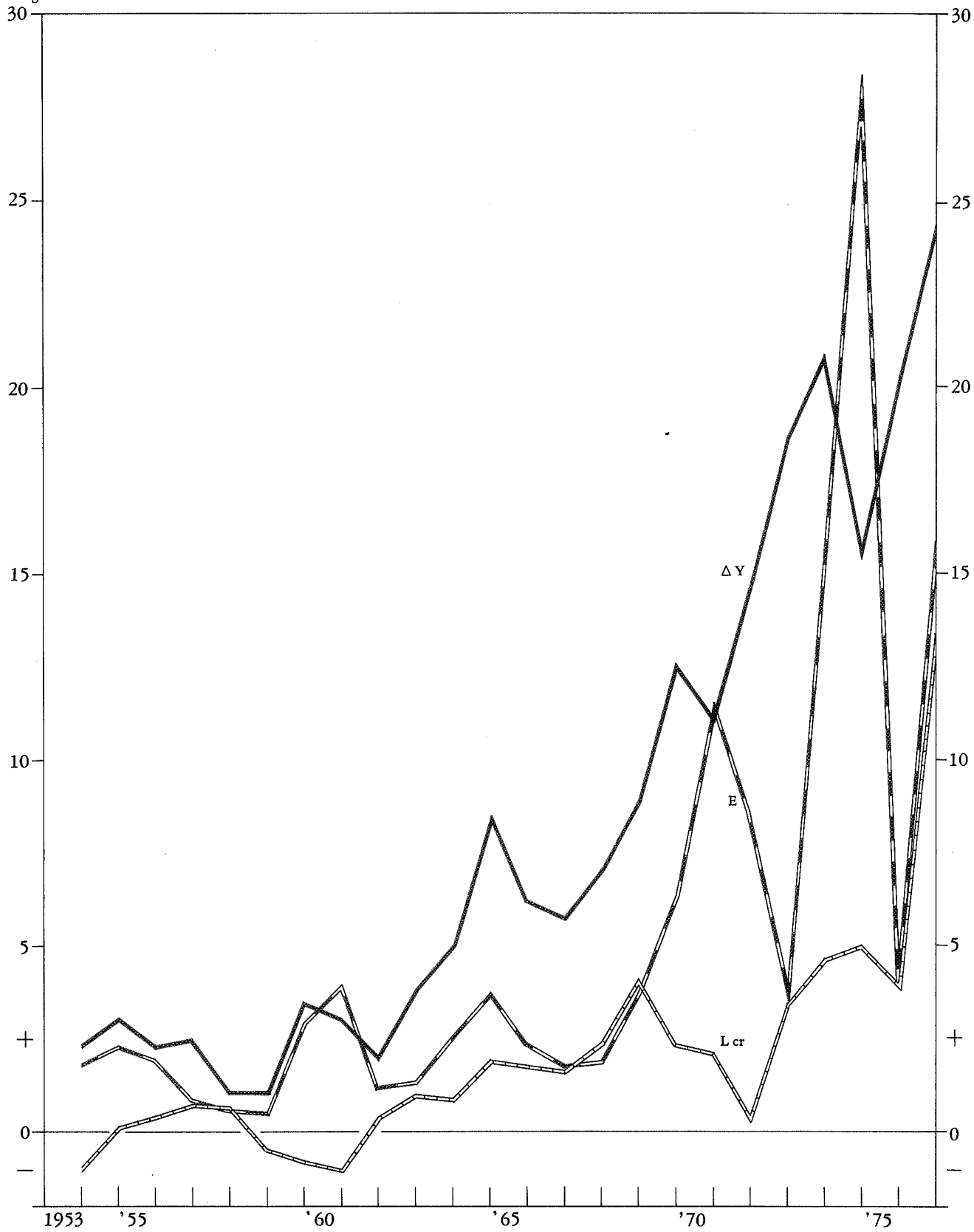
$$\text{DW} = 1.59$$

Although in this case the \bar{R}^2 in the last period does not become negative, the pattern which we found in the regressions with the percentage data is repeated: the fit is best for Holtrop's sample period and rapidly decreases as more recent data are used. It is remarkable that the value of the coefficient of Lcr hardly changes and continually comes out at more than one. The coefficient of the external monetary impulse, on the other hand, strongly decreases in value in the course of time. In the last period this coefficient no longer differs significantly from zero.

In view of these results a graphic examination of the relevant time series may be of interest. In Chart 2, both ΔY and

Billions
of guilders

CHART 2: NET NATIONAL INCOME AND MONETARY IMPULSES 1953-1976



the impulses Lcr and E are drawn. It appears that in general Lcr and E run more or less parallel with ΔY until 1970, although specifically for the years 1957 to 1961, Lcr runs contrary to ΔY , and not all turning points coincide. After 1971 both ΔY and Lcr increase substantially while the series for E shows hectic fluctuations, which give the impression of being contrary to the movements in ΔY rather than parallel. These fluctuations in the external monetary impulse are mainly caused by the extensive fluctuations in the growth of imports. In the 1967-1976 period the changes in the national income and in imports are barely correlated: the correlation between ΔY and ΔM amounts to no more than 0.06.

4. THE INFLUENCE OF LIQUIDITY ACTIVATION

Holtrop did not include liquidity activation as part of the domestic monetary impulse in the estimations of equation (5). He says the following on the matter [see Holtrop (1972.3, page 232)]:

"The activation of liquidity ($Lact$), as an impulse, could not be included in the investigation since this phenomenon cannot be measured independently, i.e. without reference to Y ".

Holtrop's objection to $Lact$ as an explanatory variable becomes understandable when we regard equation (5) together with (1) - (4) as an econometric model. In that case there is a mutual dependence between $Lact$ and ΔY ; and when measuring the influence of the liquidity activation one has to reckon with the simultaneity of the model. This feedback does not exist with regard to liquidity creation and the external monetary impulse, so that they are exogenous variables in equation (5). Hence, the least squares estimates of Holtrop are not distorted by simultaneity bias. With respect to the external monetary impulse this is true only with the proviso that Holtrop's model is not extended with the equation $\Delta M = m\Delta Y$ or another import equation in which the imports are made dependent on the national income. For the sake of convenience that is not done in this paper.

Yet, it is possible to measure the influence of liquidity activation without bias by estimating:

$$\Delta Y = \alpha_0 + \alpha_1 \text{Lcr} + \alpha_2 \text{Lact} + \alpha_3 E \quad (5^*)$$

with equations (1), (2) and (4) as restrictions. (Equation (3) is not involved, as in equation (5^{*}) the domestic monetary impulse has already been divided into its two components.) Substitution of (1), (2) and (4) in (5^{*}) yields:

$$\Delta Y = \frac{\alpha_0}{(1-\alpha_2 k)} + \frac{(\alpha_1 - \alpha_2) \text{Lcr}}{(1-\alpha_2 k)} + \frac{(\alpha_3 - \alpha_2)(B + \Delta \text{LBB})}{(1-\alpha_2 k)} + \frac{\alpha_3 \Delta M}{(1-\alpha_2 k)}$$

Now there are only "exogenous" variables to the right of the = sign. This equation is, however, non-linear, as $k = L_{t-1}/Y_{t-1}$ is not constant. Estimation with non-linear regression for Holtrop's sample period 1954 - 1969 yields the following results:

$$\begin{array}{llll} \Delta Y = 0.22 + 1.31 \text{Lcr} - 0.34 \text{Lact} + 1.39 E & \bar{R}^2 = 0.93 \\ (0.44) (5.85) & (0.75) & (6.41) & \text{DW} = 2.33 \end{array}$$

For the sake of comparison we also present the OLS results, where no account is taken of the restrictions:

$$\begin{array}{llll} \Delta Y = 0.26 + 1.42 \text{Lcr} + 0.31 \text{Lact} + 1.23 E & \bar{R}^2 = 0.92 \\ (0.60) (7.31) & (0.88) & (6.67) & \text{DW} = 2.08 \end{array}$$

Apart from a changing sign of the liquidity activation, simultaneity bias appears to be small in this period. The coefficient of the liquidity activation does not differ significantly from zero, and the size of the coefficient of the liquidity creation and the external impulse are more or less the same as that found in the previous section where the regression equation did not include liquidity activation. It proves to be correct to split up the domestic impulse when equation (5) is estimated; this is additional evidence that this regression equation may not be regarded as a verification of the relation

$$\Delta Y = \frac{1}{(k+m)} (D+E)$$

When we estimate with more recent observations, the iteration algorithm of the non-linear regression does not converge toward a plausible result, which is therefore not shown.

5. AN ALTERNATIVE MEASURE FOR LIQUIDITY ACTIVATION

Regarding the demand for money (L_v), Holtrop distinguishes between the liquidity requirement (L_{bh}) and the desire for liquidity (L_{bg}) [see Holtrop (1972.1, pages 48 & 49)].

$$L_v = L_{bh} + L_{bg}$$

The liquidity requirement concerns the demand for money as a medium of exchange; in Holtrop's analysis it is considered to be proportionate to the transactions. When assuming a fixed ratio between transactions and income, the liquidity requirement is equal to kY , and the term $k\Delta Y$ in equation (2) of the liquidity activation represents the change in the liquidity requirement. In this context k is the normal (or normative) liquidity ratio. The desire for liquidity concerns the demand for money as a store of value, which is determined mainly by the amount of wealth, by interest rates and by expectations for the future [see Kessler (1958, page 148)]. Holtrop considers a change in the liquidity requirement as an induced change in the demand for money, but he regards a change in the desire for liquidity as autonomous or spontaneous and thus as part of the domestic monetary impulse. Accordingly the liquidity activation (see section 2) is calculated with the value of the liquidity ratio at the end of the past year as k .

Apart from the fact that this method of calculation is, of course, a rather feeble reflection of the underlying theoretical idea [see e.g. Klant (1966)], the question may be asked whether it wouldn't be better if, besides a change in the liquidity requirement, other determined changes in the demand for money were to be regarded as induced, and therefore left out of the monetary impulse. With regard to the influence of interest rates such a suggestion can be found both in Holtrop (1972.3) and Kessler (1972); in Holtrop this suggestion was accompanied by the following remark (page 222):

"The bank has not, so far, worked out any comprehensive hypothesis as to the determinants of the demand function for liquidity holdings".

Since then, however, a number of empirical studies have been made in the Bank into the demand for money in the Netherlands

[see notably Fase and Kuné (1974), Kuné and Van Nieuwkerk (1974) and Den Butter and Kuné (1976)].

In order to adjust Holtrop's model in that sense, the term $k\Delta Y$ in equation (2) should be replaced by a variable ΔL^d which represents the determined change in the demand for money. Within the framework of this model it is not possible to estimate a demand-for-money function. However, the demand for money should be determined in order to calculate the liquidity activation. To that end I have made use of the empirical studies mentioned above, and in the same way that Fase and Van Nieuwkerk (1975) did when they had to choose a demand-for-money function for their model. They set their long-term elasticity of real income equal to 1, the price elasticity equal to 1, the interest-rate elasticity equal to -0.05 and the trade cycle elasticity to 0.10⁵⁾. Furthermore, because their analysis was based on quarterly figures, Fase and Van Nieuwkerk assumed partial adjustment with a coefficient of the lagged dependent variable of 0.6. That means a coefficient of 0.13 on an annual basis, which, for the sake of convenience, has been ignored here. Thus the "normative" demand for money has the following form

$$L^d = 0.37 Y r^{-0.05} c^{0.10}$$

with r the long term bond yield, c the percentage of unemployment as cyclical indicator and with a constant term of 0.37 so that the average \bar{L}^d for the period 1952 - 1976 equals the average actual money stock in that period. The "normative" increase in the demand for liquidity now becomes

$$\Delta L_t^d = L_t^d - L_{t-1}$$

and the alternative measure for the liquidity activation

$$\begin{aligned} Lact^a &= \Delta L^d - \Delta L - \Delta LBB \\ &= (0.37 Y r^{-0.05} c^{0.10} - L_{t-1}) - \Delta L - \Delta LBB \end{aligned} \quad (2^+)$$

5) Including the trade cycle as explanatory variable is a novelty of the Dutch demand for money function. It is however, questionable, whether Holtrop considers the influence of the trade cycle as a determined part of the demand for money and hence would exclude it from the domestic monetary impulse.

Since ΔL in (1) has been labelled the supply of money, liquidity activation in the above equation could be seen as a disequilibrium indicator between the demand for money and the money supply. This interpretation, however, is not in line with the original meaning which Holtrop attached to liquidity activation as part of the domestic monetary impulse. If ΔL represents the actual supply, and ΔL^d the desired demand, then the responsibility for liquidity activation is placed entirely with the supply, since the supply of money has not adapted itself to the wishes of the holders of liquidity. However, according to the original theory, the cause for liquidity activation lies with the demand side, i.e. whether holders of liquidity autonomously decide to dishoard or hoard their liquid assets. Such an interpretation is also possible for this alternative measure of liquidity activation. After all, $Lact^a$ consists of the residuals, i.e. the autonomous, non-determined elements of the demand-for-money function.

With the alternative measure for liquidity activation the following specification of equation (5) is to be estimated:

$$\Delta Y = \alpha_0 + \alpha_1 Lcr + \alpha_2 Lact^a + \alpha_3 E \quad (5^+)$$

As with the original liquidity activation it is possible to re-write this equation as a non-linear function of the exogenous variables:

$$Y_t = \{Y_{t-1} + \alpha_0 + (\alpha_1 - \alpha_2)Lcr + (\alpha_3 - \alpha_2)(B + \Delta LBB) + \alpha_3 \Delta M - \alpha_2 L_{t-1} / (1 - \alpha_2 A_t)\}$$

with $A_t = 0.37 r^{-0.05} c^{0.10}$

The estimation results with non-linear (NL) regression are to be found in Table 1. For the sake of comparison, the table also contains the OLS estimation results. Since in the non-linear regression Y , and ΔY , is the dependent variable, the \bar{R}^2 and the D.W. values are not presented in that case.

Table 1* - Estimation results for the alternative liquidity activation with an income elasticity of the demand for money of unity

1954 - 1969

$$\text{NL} \quad \Delta Y = -0.28 + 1.51 \text{ Lcr} - 0.25 \text{ Lact}^a + 1.33 \text{ E}$$

$$(0.32) \quad (5.30) \quad (0.71) \quad (7.29)$$

$$\text{OLS} \quad \Delta Y = 0.62 + 1.27 \text{ Lcr} + 0.19 \text{ Lact}^a + 1.29 \text{ E} \quad \bar{R}^2 = 0.92$$

$$(0.81) \quad (5.01) \quad (0.62) \quad (7.70) \quad \text{DW} = 2.13$$

1954 - 1976

$$\text{NL} \quad \Delta Y = 4.76 + 1.21 \text{ Lcr} + 0.71 \text{ Lact}^a + 0.24 \text{ E}$$

$$(4.75) \quad (4.08) \quad (1.71) \quad (1.77)$$

$$\text{OLS} \quad \Delta Y = 5.91 + 0.93 \text{ Lcr} + 1.58 \text{ Lact}^a + 0.12 \text{ E} \quad \bar{R}^2 = 0.90$$

$$(8.40) \quad (4.30) \quad (6.90) \quad (1.25) \quad \text{DW} = 1.10$$

1962 - 1976

$$\text{NL} \quad \Delta Y = 6.80 + 1.00 \text{ Lcr} + 0.84 \text{ Lact}^a + 0.16 \text{ E}$$

$$(5.39) \quad (3.22) \quad (2.08) \quad (1.17)$$

$$\text{OLS} \quad \Delta Y = 7.01 + 0.87 \text{ Lcr} + 1.46 \text{ Lact}^a + 0.09 \text{ E} \quad \bar{R}^2 = 0.85$$

$$(6.83) \quad (3.36) \quad (5.41) \quad (0.81) \quad \text{DW} = 1.20$$

*) t-values are in parentheses.

For Holtrop's sample period the results with non-linear regression and with OLS are on the whole in accordance; it makes no difference whether the original or the alternative measure for liquidity activation is used.

For the other periods, however, there are considerable differences between the results of the two estimation methods. The OLS estimations suggest an important and significant influence of the alternative measure of liquidity activation on a change in the national income. If, however, the simultaneity of the model is taken into account, this influence is nearly halved, while it is only in the last period that the coefficient of the

$Lact^a$ differs significantly from zero. With regard to liquidity creation and the external monetary impulse the results point in the same direction as the regressions without liquidity activation. The influence of liquidity creation is, as before, significant in the last two sample periods, although the coefficient now comes out at less than 1. The external monetary impulse again drops out as a determinant of a change in the income, if the data for the 1970s are used in the estimations.

So far both for the original and for the alternative measure of the liquidity activation, it is assumed that the long-term income elasticity of the demand for money is unity. Fase and Kuné (1974), however, found a value of 0.85 (for the period 1952 - 1971) for the elasticity of real income. In order to examine the consequences of this outcome for the Holtrop model, equation (5⁺) is estimated with a variant of $Lact^a$ (designated as $Lact^{a*}$), with the elasticity of the real income 0.85 instead of unity. The estimation results are given in Table 2. Owing to technical problems, no t-values are given in the non-linear regressions⁶⁾.

The table shows that in the original sample period of Holtrop the NL and OLS results are again well in accordance. As before, this variant of the liquidity activation does not make a significant contribution toward the change in the national income. In the last two periods, however, the NL- and OLS-results differ strongly with regard to $Lact^{a*}$.

On the whole, the conclusion may be drawn from these exercises that as part of the domestic monetary impulse liquidity activation, including the alternative measure which fits in more with the concept of the demand for money, does not have any, or very little, influence on the national income. To illustrate this once more Chart 3 shows ΔY , $Lact$, $Lact^a$ and $Lact^{a*}$ for the period 1953 - 1976. The chart shows that few bumps and dips in the time path of ΔY and the various measures for the liquidity activation coincide. A remarkable feature is the strong acceleration of the (nominal) national income in the 1970s. In this period $Lact$ decreases while $Lact^a$ and $Lact^{a*}$ only show a major increase in 1971 and 1972.

6) In the optimization algorithm the Hessian is calculated numerically and this turned out to be so inaccurate that the variance-covariance matrix could not be derived.

Table 2* - Estimation results for the alternative liquidity activation with an income elasticity of the demand for money of 0.85

1954 - 1969

NL $\Delta Y = -0.03 + 1.49 \text{ Lcr} - 0.31 \text{ Lact}^{a*} + 1.30 \text{ E}$

OLS $\Delta Y = 0.37 + 1.31 \text{ Lcr} + 0.15 \text{ Lact}^{a*} + 1.31 \text{ E}$ $\bar{R}^2 = 0.92$
 (0.69) (5.80) (0.45) (7.82) DW = 2.18

1954 - 1976

NL $\Delta Y = 3.77 + 1.43 \text{ Lcr} - 0.15 \text{ Lact}^{a*} + 0.35 \text{ E}$

OLS $\Delta Y = 4.44 + 1.37 \text{ Lcr} + 1.91 \text{ Lact}^{a*} + 0.24 \text{ E}$ $\bar{R}^2 = 0.85$
 (5.67) (5.52) (5.08) (2.13) DW = 1.26

1962 - 1976

NL $\Delta Y = 6.34 + 1.17 \text{ Lcr} + 0.19 \text{ Lact}^{a*} + 0.26 \text{ E}$

OLS $\Delta Y = 5.74 + 1.27 \text{ Lcr} + 1.74 \text{ Lact}^{a*} + 0.20 \text{ E}$ $\bar{R}^2 = 0.77$
 (4.41) (3.98) (3.78) (1.47) DW = 1.26

*) t-values are in parentheses.

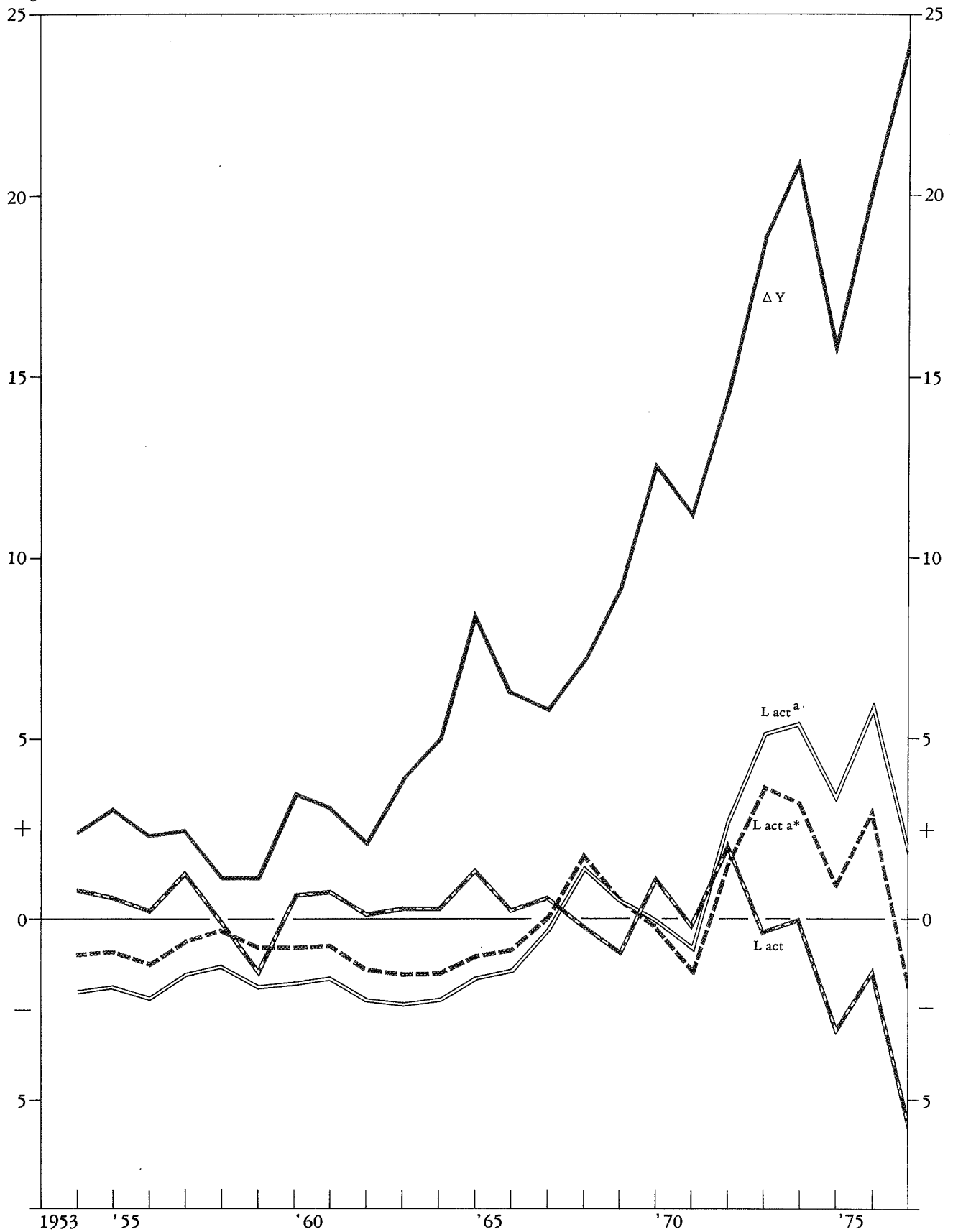
6. HOLTROP'S REGRESSION WITH QUARTERLY DATA

6.1 The data

One of the main objections brought forward by Kuipers and Wilpstra (1973) and Selden (1975) against Holtrop's Dutch monetarism is the absence of a lag structure. In order to meet that objection the lag structure of equation (5) will be examined. For such an examination annual data, however, do not offer enough observations. Furthermore, the length of interval between the observations is too large to make a proper determination of the lag structure possible. Therefore, quarterly data are constructed for the impulse analysis. It is, unfortunately, impossible to reconstruct these data for Holtrop's entire sample

Billions
of guilders

CHART 3: NET NATIONAL INCOME AND LIQUIDITY ACTIVATION 1953-1976.



period. Notably the quarterly data on expenditure on imports of goods and services are available only from 1961 onwards. The sample period is therefore 1962:I - 1976:IV. The data, as well as some technical details regarding their construction, are given in Appendix A.

On the whole these data are obtained in the same way as the annual data with the quarterly figures of the monetary impulses adding (more or less) up to the annual figures. To that end, the quarterly figure of Y , which is in fact a flow quantity, was set on an annual basis, while the ΔM from equation (4) was replaced by imports in the past year (= the past 4 quarters). Thus Holtrop's idea, that a change in imports in the current year should not be subtracted from the external impulse, is maintained.

Apart from the impulses, quarterly figures for both variants of the alternative liquidity activation are also constructed. This is done in the same manner as for the annual figures, be it that now the same lag is used for normative demand for money as by Fase and Van Nieuwkerk (1975). This demand for money is (with p as the price deflator of national income)

$$L_t^d + \text{const.} \cdot L_{t-1}^{0.60} Y^{\pi} p^{\xi} r^{-0.02} c^{0.04}$$

with $\pi = 0.40$ and $\xi = 0$ for $Lact^a$

$\pi = 0.34$ and $\xi = 0.06$ for $Lact^{a*}$

The constant term is determined so that the L_t^d over the period 1961:II - 1976:IV is on average equal to L_t in that period.

6.2 A preliminary examination of the lag structure with OLS

In order to obtain a first impression of the lag structure of equation (5), ΔY was regressed for the period 1964:I - 1976:IV with the monetary impulses one by one. The impulses are lagged 0 - 8 quarters - it is unlikely that lags of more than 2 years play a role - and it is examined which lag yields the best fit with regard to \bar{R}^2 and t -values. Subsequently the "best" lags of the impulses are assembled. Table 3 contains a compilation of

Table 3 - OLS estimation results for 1964:I - 1976:IV

Equation	Dependent variable	Explanatory variables										\bar{R}^2	DW
	ΔY	Lcr	E	E ₋₆	Lact	Lact ^a	Lact ^{a*}	DL	DF ₋₁	DF ₋₂			
[1]		0.63 (2.83)	0.23 (1.95)								0.20	0.70	
[2]		0.32 (1.61)		0.55 (5.01)							0.44	0.71	
[3]		1.51 (6.02)	0.31 (3.17)		1.29 (5.04)						0.48	0.78	
[4]		1.12 (5.07)		0.52 (5.95)	1.09 (5.19)						0.64	0.92	
[5]		0.74 (3.87)		0.30 (2.77)		0.87 (4.42)					0.60	0.85	
[6]		0.77 (3.22)		0.44 (4.05)			0.75 (2.92)				0.52	0.75	
[7]								0.67 (3.95)	1.36 (2.96)		0.34	1.05	
[8]								0.54 (3.43)	1.55 (3.76)	1.52 (3.67)	0.48	0.87	

the results. As the explanatory variables (but not the dependent variable, see further on) have a seasonal pattern, all equations are estimated with seasonal dummies. These results are not given in the table.

Liquidity creation appears to yield a significant coefficient notably when unlagged. The value of this coefficient lies below unity when $Lact$ is not one of explanatory variables, which is considerably lower than in the regressions with the annual data.

The external monetary impulse yields a good fit especially when lagged 6 quarters. The coefficients of the E_{-6} in equations [2] and [4] are about twice as large as the coefficients of the unlagged external impulse in the corresponding equations [1] and [3]. The value of the coefficient of Lcr decreases, however, in [2] and [4], compared with [1] and [3]. This could be partly the result of the fact that Lcr and E_{-6} are more correlated (0.37) than Lcr and E (0.15).

All measures of liquidity activation show the best fit when unlagged. It must be noted that only OLS is applied and that therefore no account is taken of the simultaneity. Noteworthy is the influence exerted by the inclusion of $Lact$ as an explanatory variable on the value of the coefficient of Lcr .

Apart from the absence of a lag structure, Rutten (1973) and Selden (1975) criticize Holtrop's monetarism for paying attention to credit (liquidity creation) rather than to the total money stock as the determinant of income. In order to evaluate these remarks, and to compare Dutch monetarism with a form of American monetarism, a St. Louis equation is estimated for the Netherlands.

In the St. Louis equation

$$\Delta Y = f(\Delta L, \Delta F)$$

a change in the nominal income, ΔY , is explained by a change in public expenditure, ΔF , representing fiscal policy and a change in the money stock, ΔL , representing monetary policy. Kuné (1972) estimated such a St. Louis equation for the Netherlands, using Almon lags and hence following Andersen and Jordan (1968) in their estimation method. With regard to the data I followed Kuné

as much as possible, be it that where Kuné used seasonally adjusted data, I use the unadjusted data. Furthermore, the dependent variable, ΔY , is the gross national income in Kuné, while here the net national income is taken in order to keep the results comparable to Holtrop's calculations. As in Holtrop's model, the ΔL is the change in the money stock, while for ΔF the change in public expenditure on a cash basis is chosen. The use of the latter as representative of fiscal policy is open to discussion. Kuné considered several alternatives, but these did not affect his results. Therefore, in this paper we stick to Kuné's preferred measure of fiscal policy.

In this section, the lag structure of the St. Louis-equation is studied in the same way as that of Holtrop's equation. Two representative outcomes are the equations [7] and [8] in table 3. The ΔL shows the best fit without lag. The ΔF on the other hand, yields the highest t-values when lagged one and two quarters. It is remarkable that according to these equations both the monetary and the fiscal policy have a significant influence on the national income. Especially with regard to fiscal policy this is a notable aspect. If the effects of ΔF_{-1} and ΔF_{-2} are added up, a coefficient value of about 3 is attained. In American studies, however, fiscal policy has hardly any effect, and Kuné even found the wrong sign with his Almon-lags. With regard to monetary policy Kuné found a total multiplier of over 2, while it amounts to only 0.67 and 0.54 in equations [7] and [8] respectively. Furthermore, in Kuné, the average lag of the ΔL was over 3 quarters, whereas here the best results are obtained without lag.

The regressions in table 3 unanimously yield a low value for the DW-test statistic, which indicates autocorrelation of the disturbances. When the equations were re-estimated with GLS, however, the results proved difficult to interpret. This aspect is not gone into further, as in the following section the lag structure of the disturbances is examined together with the lag structure of the explanatory variables.

7. EXAMINATION OF THE LAG STRUCTURE BY MEANS OF TRANSFER FUNCTIONS

7.1 Methodology

The exercises in the previous section only give a first impression of the lag structure of the Holtrop equation. With the aid of transfer functions, this structure can be examined more thoroughly and in a more general way. For the construction of these transfer functions we follow Box and Jenkins (1970) with identification by means of the cross correlations between the prewhitened input and output, maximum likelihood estimation, and diagnostic checking with the aid of the portmanteau or Box-Pierce χ^2 -test statistic. Apart from the statistical diagnostics the transfer function models should of course also be economically plausible. Hence in Holtrop's equation only coefficients for the monetary impulses with the expected positive sign are considered.

In this section, only the finally preferred transfer function models are presented. The road which led to this choice, is described in Appendix B. A major technical problem which arose during the construction of the transfer functions should, however, be mentioned here and that is the problem of the functional form. The functional form of Holtrop's equation, relating ΔY with D and E, should in principle be maintained in the transfer functions.⁷⁾ It appears, however, that both for the dependent and for the independent variables differencing is necessary with regard to the original specification in order to obtain a stationary series. This has brought about that in the transfer function models, the acceleration of the national income ($\Delta\Delta Y$) is explained by means of the changes in the monetary impulses (Holtrop equation) and the acceleration of the money stock and public expenditure (St. Louis equation) respectively. For a discussion on such a change in specification on behalf of the stationarity of the regressed series (and the residual noise!) see Courakis (1978), Hendry and Mizon (1978) and Williams (1978).

7) Thus a loglinear specification cannot be used as the impulses may become negative. For the St. Louis equation, a log linear functional form is possible, but for the sake of comparability and uniformity, it was decided not to proceed along these lines.

The problem of the seasonality of the series is linked with the functional form.⁸⁾ All explanatory variables have a seasonal pattern, and it proves necessary to include a seasonal difference for most series. For the sake of uniformity an attempt was made to treat as many explanatory variables as possible in this way. The seasonal movements in the external impulse, however, are so weak that this approach cannot be applied in that case. Furthermore, the quarterly figures for the dependent variable, the net national income, are without a seasonal pattern. This is the result of the way in which these figures are constructed on behalf of the monetary analysis. All these factors together give rise to a rather complicated form of the transfer function models. In the transfer function model for Holtrop's equation $\Delta\Delta Y$ is explained by means of the change in liquidity creation and liquidity activation with respect to the previous year ($\Delta^4 Lcr$, $\Delta^4 Lact$) and by means of the change of the external monetary impulse with respect to the previous quarter (ΔE). In the St. Louis transfer function model $\Delta\Delta Y$ is a function of $\Delta\Delta^4 L$ and $\Delta\Delta^4 F$.

7.2 A transfer function model for Holtrop's equation (HTF)

For Holtrop's original equation with the liquidity creation and the external monetary impulse as explanatory variables, the following function is chosen (sample period 1962:I - 1976:IV).

$$\Delta\Delta Y = 0.17B\Delta^4 Lcr + (0.14B^5 + 0.24B^6)\Delta E + (1 - 0.52B^3)a \quad (HTF1)$$

(1.57) (1.39) (2.25) (4.02)

$$\bar{\chi}_{17}^2 = 13.3 \qquad \bar{\chi}_{17}^2 = 16.6 \qquad \bar{\chi}_{19}^2 = 13.3 \quad \sigma_a = 0.901$$

(Legenda: $\Delta x = x_t - x_{t-1}$, $\Delta^4 x = x_t - x_{t-4}$, $Bx = x_{t-1}$; $B\Delta^4 Lcr$ therefore means $Lcr_{t-1} - Lcr_{t-5}$; the t-values of the coefficients (in parentheses), the $\bar{\chi}^2$ -values of the Box-Pierce test statistic (corrected for bias) and the standard deviation of the residuals (σ_a , in billions of guilders) are given under the equation).

8) Since this method of time series analysis makes explicit allowance for seasonal movements, the series are not adjusted beforehand; neither were seasonal dummies used, as in the preceding regressions.

In this transfer function model liquidity creation is included with a one quarter lag, while the external impulse occurs with a lag of 5 and 6 quarters. The residual noise has a MA(3) parameter⁹⁾.

The influence of liquidity creation on the national income turns out to be small according to this transfer function model, smaller than the previous results with quarterly and annual regressions over the same period. The influence of the external impulse, however, with a coefficient which differs significantly from zero when lagged 6 quarters, is in accordance with the previous results.

The above transfer function model seems to be reasonably satisfactory, in view also of the values of the Box-Pierce χ^2 test-statistics. Yet this function forms no basis for decisive conclusions, certainly as far as the influence and the lag structure of the external impulse are concerned. The pattern of the cross correlations hardly points in the direction of such an outcome and the above function has only been found after some trial and error. This is gone into in more detail in Appendix B; the following alternative model is presented here in order to illustrate the uncertainty regarding the influence and the lag structure of the external impulse.

$$\Delta\Delta Y = 0.09\Delta^4 Lcr + B(-0.22 - 0.24 + 0.35 B^4 + 0.35 B^5)\Delta E/(1-0.84 B^4) +$$

(0.88) (2.05) (2.52) (3.74) (3.65) (5.76)

$$\chi_{14}^2 = 14.5$$

$$\chi_{14}^2 = 8.2$$

$$+ (1-0.31B^3)a$$

(1.99)

$$\sigma_a = 0.794$$

(HTF2)

$$\chi_{19}^2 = 17.6$$

9) This is a peculiarity which also occurs when constructing an ARIMA-model for Y. A very tentative explanation is that in the compilation of the quarterly national income data notably the first and the last figures of a year were adjusted in order to meet the restriction that the quarterly figures add up to the annual figure. In fact, inspection of this series reveals that when the figure is relatively high for the first quarter, it is low for the fourth, and vice versa.

In this equation, the total (long term) multiplier of the external impulse amounts to no less than 1.45. All coefficients of the external impulse are significant, but the lag structure is so complicated that the model has to be rejected out of economic implausibility. Presumably the weak seasonal movements in E, which cannot be accounted for by a seasonal difference are to a major extent responsible for these odd results. The conclusions may be drawn that the lag structure in the Holtrop equation is difficult to assess by means of this method of time series analysis and that there are serious doubts about the influence of the monetary impulses on the national income.

Table 4 shows the transfer function models for the Holtrop equation with the various measures of liquidity activation. For

Table 4 - The transfer function models of the Holtrop equation with liquidity activation

$\Delta\Delta Y = 0.21B\Delta^4 Lcr + (0.17B^5 + 0.23B^6) \Delta E + 0.36\Delta^4 Lact + (1-0.52B^3)a \text{ (HTF3)}$				
(2.02)	(1.79)	(2.24)	(2.66)	(3.90)
$\bar{X}_{16}^2 = 15.5$	$\bar{X}_{16}^2 = 17.1$	$\bar{X}_{16}^2 = 14.8$	$\bar{X}_{19}^2 = 12.6$	$\sigma_a = 0.850$
$\Delta\Delta Y = 0.19B\Delta^4 Lcr + (0.13B^5 + 0.23B^6) \Delta E + 0.14\Delta^4 Lact^a + (1-0.54B^3)a \text{ (HTF4)}$				
(1.79)	(1.32)	(2.11)	(1.03)	(4.21)
$\bar{X}_{16}^2 = 13.1$	$\bar{X}_{16}^2 = 15.8$	$\bar{X}_{16}^2 = 9.5$	$\bar{X}_{19}^2 = 12.3$	$\sigma_a = 0.901$
$\Delta\Delta Y = 0.21B\Delta^4 Lcr + (0.14B^5 + 0.23B^6) \Delta E + 0.14\Delta^4 Lact^{a*} + (1-0.53B^3)a \text{ (HTF5)}$				
(1.84)	(1.34)	(2.14)	(1.02)	(4.10)
$\bar{X}_{19}^2 = 14.2$	$\bar{X}_{18}^2 = 15.8$	$\bar{X}_{19}^2 = 10.4$	$\bar{X}_{19}^2 = 12.1$	$\sigma_a = 0.901$

the liquidity creation and the external impulse the specification is analogous to (HTF1). The liquidity activation is included without a lag; lags do not yield any useful results here. Only the Lact shows a significant coefficient. Again it should be noted that simultaneity bias can play a role here¹⁰⁾. Therefore we must draw the conclusion that liquidity activation, too, does not, in any form, contribute toward a monetarist explanation of the national income.

7.3 A transfer function model for the St. Louis equation (SLTF)

In contrast to the Holtrop equation, the pattern of the cross correlations for the St. Louis equation does lead directly to the preferred model:

$$\Delta\Delta Y = 0.19B^3 \Delta\Delta^4 L + 0.46B\Delta\Delta^4 F + (1 - 0.48B^3)a \quad (\text{SLTF1})$$

(1.23) (2.16) (3.69)

$$\bar{x}_{18}^2 = 12.7 \quad \bar{x}_{18}^2 = 11.7 \quad \bar{x}_{17}^2 = 17.9 \quad \sigma_a = 0.897$$

The money stock is included with a single lag of 3 quarters, and public expenditure with a single lag of one quarter.

From this model it appears that the money stock as representative of monetary policy is just as unsatisfactory in the explanation of the national income as liquidity creation in the model for the Holtrop equation. Thus, from this point of view, one cannot assess whether for the Netherlands American (viz. St. Louis) or Dutch monetarism is more suitable.

The outcome of the above transfer function model is remarkable, however, with regard to the influence of fiscal policy. The coefficient is significant and much larger than that of monetary policy. It is true that the coefficients do not represent elasticities, as the specification is linear, but it is easy to calcu-

10) It does not seem worthwhile here to make allowance for this simultaneity. In that case an identification and estimation method should be developed for non-linear transfer functions.

late that the weight of F in the explanation of Y is larger than of L. It must be mentioned again that in the original St. Louis equation for the U.S. [Anderson and Jordan (1968)] and later in the equation of Kuné (1972) for the Netherlands, fiscal policy was not found to have any effect. Recently, the discussion on the role of fiscal policy in the St. Louis equation has gathered new momentum in the U.S. after re-estimations with recent data. [see Friedman (1977) and Carlson (1978)].

7.4 Conclusion

The root mean square errors in table 5 give an impression of the explanatory performance of the transfer function models and the regressions of the previous section. For the sake of comparison the results for $\Delta\Delta Y = 0$ and the ARIMA model for ΔY are also shown (see Appendix B).

Table 5 - The Root Mean Square Errors (RMSE) 1964:I - 1976:IV

<u>Equation</u>	<u>RMSE in billions of guilders</u>
[2] from table 3	1.252
[4] from table 3	0.990
[5] from table 3	1.045
[6] from table 3	1.148
[8] from table 3 (St. Louis)	1.355
$\Delta\Delta Y = 0$	1.008
ARIMA model ΔY	0.912
HTF1	0.869
HTF2	0.746
HTF3	0.803
HTF4	0.862
HTF5	0.863
SLTF1	0.871

The table shows that on average the residuals of the simple OLS equations in the original functional form without differencing are larger than those of the transfer function models. With regard to the simple scheme $\Delta\Delta Y = 0$ and, to an even greater extent, to the ARIMA model for ΔY , the transfer function models hardly offer any extra explanation for the national income. The best performance is given by the model with the complicated lag structure for the external impulse, which we reject on theoretical grounds. In addition, the table makes it very clear that for the Netherlands the St. Louis monetarism is not to be preferred to Holtrop's Dutch monetarism.

The lag structure of the Holtrop equation proves to be very difficult to trace by means of transfer functions. For this there are several reasons. In the first place the monetary impulses hardly contribute to the explanation of $\Delta\Delta Y$, as can be seen in the above table. The fact that the cross correlations hardly show any significant (positive) values or not even any regular pattern forms a clear omen. That is the reason why the lag structure, if any, is so difficult to identify. In addition, most explanatory variables should be included in the transfer function model with fourth order differences, owing to seasonal movements. The dependent variable, Y , on the other hand, has been constructed without seasonal pattern. These seasonal movements cloud the lag structure; they are, in my view, largely responsible for the specification problems with regard to the external impulse. However, I do not see any other possibility for solving this problem within the framework of time series analysis. A mechanical method of seasonal adjustment may filter the series in such a way that an originally simple lag structure is complicated beyond recognition. Another impediment in the search for the correct lag structure is that the Holtrop equation is probably very unstable. Owing to the (relatively) limited number of observations this has not been checked in this section; the results for the annual figures, however, seem to warrant such a conclusion.

8. SUMMARY AND CONCLUSIONS

This paper goes into the influence of monetary impulses on the national income. The study is centered on three main points. In the first place Holtrop's regression equation is re-estimated with annual data. This equation turns out to be unstable since extension of the sample period with recent data causes the fit of the regression to decrease dramatically.

Secondly, the influence of liquidity activation as part of the domestic monetary impulse is examined. The estimations take account of the simultaneous character of this variable in Holtrop's model. Apart from the liquidity activation, calculated according to the original formula of Holtrop, two alternative measures are designed for this impulse incorporating results of the demand for money studies. However, for neither of these measures of liquidity activation can an influence on the national income be measured unequivocally. In Holtrop's sample period (1954 - 1969) there was clearly no influence. When more recent data are used, the results differ to such an extent, depending on the regression technique used, that no definite conclusions may be drawn. In addition the calculations are of course frustrated by the instability of the other explanatory variables in the equation, notably of the external monetary impulse.

Thirdly, the lag structure of the regression equation of Holtrop is examined, for the sample period 1962:I - 1976:IV using quarterly data. Firstly, those lags for the explanatory variables are traced, where the t-values and the \bar{R}^2 show the highest values in simple OLS regressions. Liquidity creation yields the best results with no lag, while the external monetary impulse shows the best fit lagged six quarters. The coefficients of the liquidity activation differ, unlagged, significantly from zero, but the question remains to what extent simultaneity bias plays a role here.

Next the lag structure of the Holtrop equation is examined with transfer function analysis. The influence on national income turns out to be small for liquidity creation where now a one quarter lag proves to be the most satisfactory. For the external impulse a lag is found of 5 and 6 quarters, and the liquidity activation is again included unlagged. The outcomes are, however, extremely dubious, notably for the external impulse. The cross correlations, which are calculated to identify the lag structure, show not one

recognizable pattern and they are virtually nowhere significant so that, according to the definition of causality by Granger (1969) [see also Pierce and Haugh (1977)] there is no question of a causal relationship between the monetary impulses and the national income.

An important aspect of the transfer function analysis is that the series are to be differenced one more time in comparison with the specification of the Holtrop equation. It is possible that this differencing obscures a relationship which is present in the original functional form [see Hendry and Mizon (1978, page 56)]. It is, however, more likely that the estimations of the coefficients in the original specification are flattered by trend correlation. This is illustrated by the fact that the value of the coefficient of liquidity creation is considerably higher when annual data are used than in the simple regressions with quarterly data while these values are in turn higher than those in the transfer function models. It would seem that trend correlation plays the most prominent role in the annual regressions.

The main conclusion from this paper is that very little influence of the monetary impulses on the (net nominal) national income can be measured, and that, if this influence exists at all, the stability of the relation is poor. In this respect Dutch monetarism offers an inadequate explanation for the course of Dutch national income. Analogous calculations with the St. Louis equation show that for the Netherlands the same is true with regard to this American monetarism.

Holtrop's regressions may therefore not be regarded as an attempt to extend the original conditional model to a behavioural model. Holtrop's monetary analysis is meant to uncover monetary disturbances and to name the conditions under which they occur. As such, this analysis plays a major role in the description of the economic situation in the Netherlands. Holtrop's model, however, does not offer a suitable skeleton for a monetary behavioural model, by means of which the economic situation can be explained and forecasted. To that end other methods and models should be applied.

APPENDIX A - ON THE DATA

The annual figures of the impulse analysis are given in table A1 and the quarterly figures in table A2. The annual figures are based on table 4.3 in the Netherlands Bank's Annual Reports, while the quarterly figures are mainly derived from the publication "Monetair-statistische jaar- en kwartaalreeksen" and the Quarterly Statistics of the Netherlands Bank.

The following list of symbols contains specific remarks on sources and other characteristics of the data.

- B : national liquidity surplus (= inflow of foreign funds)
- Lcr : domestic liquidity creation (corrected for switching)
- Y : net nominal national income on a yearly basis (end-of-period figures)
- L : domestic money stock (corrected for switching, end-of-period figures); it must be noted that ΔL is calculated as $Lcr + B$ and not as the first difference of this series. Owing to the correction of breaks in the series there are small deviations.
- LBB : liquid assets held by firms abroad (end-of-period figures)
- M : expenditure on imports of goods and services, on a cash basis
- p : price deflator of net national income (1970=1)
- c : registered male labour reserve as a % of the male labour force excl. self-employed (seasonally adjusted);
(source: Maandverslag Arbeidsmarkt, Ministry of Social Affairs; the annual figures are quarterly averages)
- r : (up to 1975:II) average yield of 18 long-term government loans; (from 1975:III onwards) average yield on two 5%-5¼% government loans; the annual figures are quarterly averages.

The data are compiled in October 1977:
last Annual Report: 1976
last Quarterly Statistics: 1977 No. 2.

Table A1 - Monetary impulses and their components: yearly data (in millions of guilders)

	Inflow of foreign funds	Liquidity creation	Increase in money stock	Liquidity activation	Domestic monetary impulse	External monetary impulse	Auxiliary series:				Imports of goods and services
	B	Lcr	AL	Lact	D	E	Net nomi- nal national income	Money stock	Liquid assets held by firms abroad	LBB	M
1953	1250	-921	329	853	-68	1847	23080	11204	165	8984	
54	632	160	792	677	837	2338	26150	11994	186	10669	
1955	435	454	889	280	734	1971	28503	12884	96	12295	
56	-1036	762	-274	1372	2134	894	31030	12610	140	14181	
57	-282	698	416	6	704	581	32150	13026	173	15011	
58	2284	-465	1819	-1346	-1811	557	33260	14841	150	13307	
59	1381	-752	629	689	-63	2959	36740	15468	385	14650	
1960	1701	-1002	699	769	-233	3956	39780	16165	197	17093	
61	267	391	658	139	530	1227	41810	16822	225	18025	
62	137	993	1130	287	1280	1379	45615	17940	339	19153	
63	878	890	1768	242	1132	2597	50600	19689	290	20921	
64	115	1950	2065	1393	3343	3722	59081	21731	132	24686	
1965	83	1785	1868	257	2042	2398	65285	23579	289	26844	
66	-269	1644	1375	644	2288	1828	71030	24970	345	28885	
67	308	2390	2698	-209	2181	1927	78060	27698	327	30522	
68	-73	4124	4051	-902	3222	3649	86950	31793	332	34239	
69	863	2358	3221	1209	3567	6350	99520	34974	498	39560	
1970	1689	2126	3815	-173	1953	11551	110660	38825	771	49149	
71	2682	435	3117	2124	2559	8602	125270	42120	656	55184	
72	3223	3456	6679	-395	3061	3982	143930	48804	646	55953	
73	2370	4669	7039	18	4687	15701	164821	55843	673	69257	
74	3307	5010	8317	-3039	1971	28337	180600	64160	741	94219	
1975	3925	3995	7920	-1396	2599	4903	200850	72080	1411	94527	
76	555	13383	13938	-5505	7878	15873	225185	86018	1711	109545	

Table A2: Monetary impulses and their components: quarterly data (in millions of guilders)

		Inflow of foreign funds	Liquidity creation	Increase in money stock	Liquidity activation	Domestic monetary impulse	External monetary impulse	Auxiliary series:	Net national income	Money stock	Liquid assets held by firms abroad LBB	Imports of goods and ser- vices M
		B	Lcr	Δ L	Lact	D	E		Y	L		
1961	II	24	150	174	-5	145			40560	16839	215	17872
	III	158	-155	3	250	95			41090	16842	182	17996
	IV	-113	93	-20	272	365			41810	16822	225	18896
1962	I	20	123	143	255	378	221		42520	16963	113	18588
	II	25	700	725	-480	220	340		43400	17680	219	18708
	III	104	-115	-11	425	310	510		44460	17669	237	19548
	IV	-12	285	273	84	369	308		45615	17940	339	19768
1963	I	214	205	419	241	446	27		46770	18354	133	18664
	II	251	292	543	-119	173	690		47960	18891	176	20292
	III	396	188	584	40	228	846		49440	19469	135	21512
	IV	17	205	222	80	285	1034		50600	19689	290	23216
1964	I	-356	758	402	1076	1834	639		54057	20086	157	23176
	II	-703	1015	312	248	1263	501		55753	20395	227	24828
	III	417	275	692	-48	227	1311		57416	21080	191	25232
	IV	757	-98	659	11	-87	1271		59081	21731	132	25508
1965	I	223	593	816	-141	452	563		60880	22539	119	24588
	II	-272	935	663	-55	880	142		62500	23195	111	26516
	III	265	105	370	168	273	744		63960	23561	115	27132
	IV	-133	152	19	295	447	949		65285	23579	289	29140
1966	I	-553	470	-83	745	1215	201		67035	23496	259	27724
	II	-107	1559	1452	-972	587	351		68290	24964	219	28508
	III	170	-336	-166	662	326	752		69680	24796	231	29412
	IV	221	-49	172	194	145	524		71030	24970	345	29896
1967	I	-132	665	533	-27	638	182		72670	25509	416	28696
	II	-285	1714	1429	-809	905	162		74260	26953	354	30544
	III	349	222	571	45	267	700		76045	27531	386	30688
	IV	376	-211	165	624	412	882		78060	27698	327	32156
1968	I	-189	1414	1225	-264	1150	455		80320	28936	168	31908
	II	-256	2406	2150	-1459	947	374		82400	31110	226	32832
	III	298	19	317	439	458	1329		84600	31430	301	34512
	IV	74	285	359	483	768	1492		86950	31793	332	37704
1969	I	336	410	746	713	1123	1186		91125	32548	400	35036
	II	-288	2570	2282	-1409	1161	1391		93875	34855	509	39112
	III	-125	314	189	846	1160	1015		96680	35046	515	39048
	IV	940	-936	4	1042	106	2758		99520	34974	498	45044
1970	I	35	1394	1429	-423	971	1692		102370	36416	494	41680
	II	441	1941	2382	-1543	398	3496		105180	38821	655	50688
	III	1135	-1057	78	1091	34	3620		107840	38900	468	49736
	IV	78	-152	-74	788	636	2743		110660	38825	771	54492
1971	I	890	-156	734	1096	940	3123		115380	39566	597	51308
	II	781	1186	1967	-820	366	1366		118560	41552	540	53256
	III	610	-516	94	1043	527	2730		121770	41647	528	58264
	IV	401	-79	322	747	668	1383		125270	42120	656	57908
1972	I	839	930	1769	-439	491	1392		129880	43897	876	52640
	II	763	2900	3663	-2000	900	949		134230	47558	683	54772
	III	1240	-157	1083	380	222	714		138770	48643	829	55576
	IV	381	-217	164	1828	1611	927		143930	48804	646	60824
1973	I	1645	1872	3517	-1433	439	3690		149907	52321	589	61048
	II	-221	3235	3014	-1288	1947	3359		154718	55335	542	69280
	III	23	718	741	915	1633	3442		159647	56076	649	68824
	IV	923	-1156	-233	2026	870	5210		164821	55843	673	77876
1974	I	595	1917	2512	-617	1300	6465		170160	58355	587	84872
	II	604	4452	5056	-3489	963	6465		174990	63411	676	92332
	III	897	-569	328	1097	528	8315		178650	63739	577	98892
	IV	1211	-790	421	111	-679	7101		180600	64160	741	10078
1975	I	1056	1187	2243	-1951	-764	2350		182120	66403	989	89056
	II	2155	3100	5255	-4054	-954	2253		185650	71658	1075	92380
	III	389	-1062	-673	3213	2151	-765		192790	70985	1291	93412
	IV	325	770	1095	1753	2523	1065		200850	72080	1411	103260
1976	I	1185	3779	4964	-2127	1652	3775		208565	77044	1343	99688
	II	74	6915	6989	-4886	2029	4077		214214	84033	1327	108456
	III	-1103	2384	1281	773	3158	3307		219153	85314	1210	111520
	IV	399	305	704	1139	1444	4718		225185	86018	1715	118516

APPENDIX B - THE CONSTRUCTION OF THE TRANSFER FUNCTIONS

This appendix contains an account of the choice of the transfer functions presented in the main text of this paper.

B1 ARIMA models

The first step in the analysis of the transfer functions is the construction of ARIMA models for the explanatory variables (inputs). The results are given in table B1. A model for ΔY , the dependent variable (output), is also calculated in order to compare the (within sample) predictive performance of this model with the transfer function models in table 5. Note that the model for ΔY is not used for the pre-whitering in the calculations of the cross correlations.

In view of the values of the Box-Pierce test statistic the residuals of the ARIMA models do not differ significantly from white noise, and these models are appropriate filters to pre-whiten the series. When constructing the models we tried to respect the principle of parsimony as much as possible, and thus to estimate as few parameters as possible. Notably when parameters were supposed to be "odd" from an economic point of view, these parameters were omitted. E.g., in the case of Lact there is some residual autocorrelation at lag 3 and lag 7. As no reason, exists, why the liquidity activation would show such a periodicity, no parameters were estimated.

In one instance an exception was made to this rule: in the model for ΔY a significant MA(3) parameter is retained. Footnote 8 gives a very tentative explanation for this phenomenon.

The residual standard deviation turns out to have more or less the same size in all models. The noise of the model for the public expenditure shows the smallest fluctuations while the model for the external impulse is somewhat prominent at the other end. The discussion of chart 2 already pointed out the strong movements shown by this impulse especially during the past few years.

The models in table B1 are not the only possible specifications for these series. As is usual in the construction of ARIMA models, one is sometimes left with several alternatives, from which a choice must be made. In this case uniformity in the models was an important point in this choice. For instance,

Table B1 - ARIMA models*

1. Net national income

$$\Delta\Delta Y = 0.093 + (1-0.48B^3)a$$

(1.57) (4.11)

$$\chi^2_{14} = 10.3$$

$$\sigma_a = 0.859$$

2. Liquidity creation

$$(1-0.48B)\Delta^4 Lcr = (1-0.56B^4)a$$

(4.07) (4.09)

$$\chi^2_{14} = 9.6$$

$$\sigma_a = 0.843$$

3. External monetary impulse

$$\Delta E = (1-0.28B^4)(1-0.24N^8)a$$

(2.00) (1.43)

$$\chi^2_{14} = 14.4$$

$$\sigma_a = 1.132$$

4. Liquidity activation

$$\Delta^4 Lact = (1-0.42B^4)a$$

(3.17)

$$\chi^2_{15} = 16.2$$

$$\sigma_a = 0.796$$

5. Alternative measure of liquidity activation (with an income elasticity of 1)

$$(1-0.45B)\Delta^4 Lact^a = (1-0.36B^4)a$$

(3.58) (2.67)

$$\chi^2_{14} = 13.3$$

$$\sigma_a = 0.723$$

6. Alternative measure of liquidity activation (with an income elasticity of 0.85)

$$(1-0.48B)\Delta^4 Lact^{a*} = (1-0.42B^4)a$$

(3.80) (3.03)

$$\chi^2_{14} = 11.4$$

$$\sigma_a = 0.745$$

7. Money stock

$$\Delta\Delta^4 L = 0.196 + (1-0.39B^4)a$$

(3.09) (2.54)

$$\chi^2_{14} = 14.1$$

$$\sigma_a = 0.741$$

8. Public expenditure

$$\Delta\Delta^4 F = 0.056 + (1.045B)(1-0.36B^4)a$$

(2.82) (3.68) (2.64)

$$\chi^2_{13} = 10.8$$

$$\sigma_a = 0.405$$

* t-values in parentheses, χ^2_n = Box-Pierce test statistic, with n degrees of freedom, σ_a : standard deviation of the residuals in billions of guilders, sample period 1961:II-1976:IV; E 1962:I-1976:IV

differencing Lact was unnecessary; an AR (4) parameter would have been sufficient. As this model does not fit the pattern, it was not chosen.

B2 Cross correlations

In order to identify the lag structure in the transfer functions, the cross correlations between ΔY and the explanatory variables, pre-whitened with the aid of the ARIMA models, are calculated: these cross correlations are drawn in chart B1. Cross correlations within the dotted lines do not differ significantly from zero.

None of the pictures presents a clear pattern. In addition, there are hardly any significant correlations. This is the first indication that none of the explanatory variables will explain a large part of the variation in ΔY . At the same time the absence of flowing patterns indicates that there are no so-called denominator parameters, i.e. distributed lags. In the transfer functions, therefore, only numerator parameters, i.e. single lags, are estimated.

Not one cross correlation between Y and Lcr is significant. The highest values occur at lag 0 (negative) and lag 3 (positive). Since we suppose that Lcr has a positive influence on ΔY , only positive correlations are of importance. (This is also true of all other variables.) Therefore, it seems in order to include the liquidity creation with a three quarter lag.

The cross correlations between E and ΔY , too, present a very unclear picture. Here there are negative values at lags 1 and 7, and positive values at lags 5, 6 and 10. Since a lag of $2\frac{1}{2}$ year seems too long, only simple lags of 5 and 6 quarters are tried in the transfer function.

For Lact a significant positive correlation is found at lag 0 and a negative one at lag 3. The alternative measures of liquidity activation seem completely uncorrelated with Y.

Although there are, again, no significant cross correlations, a simple lag of 3 quarters for the money stock and a lag of 1 quarter for public expenditure seem best in the case of the transfer function model for the St. Louis equation.

Apart from the lag structure of the explanatory variables, the structure of the noise of the transfer function models must also be identified. This is done by means of the auto-correlations of provisional estimates of the residuals. For nearly all explanatory variables the identification points in the direction of a MA(3) process for the residual noise. This is wholly in accordance with the outcome of the ARIMA model for Y.

B3 The transfer functions

First, for Holtrop's original specification, a transfer function model with $\Delta^4 \text{Lcr}$ lagged 3 quarters and ΔE lagged 5 and 6 quarters is estimated:

$$\Delta \Delta Y = 0.12B^3 \Delta^4 \text{Lcr} + (0.11B^5 + 0.24B^6) \Delta E + (1-0.42B^3)a$$

(0.73) (1.06) (1.99) (2.94)

$$\bar{\chi}_{17}^2 = 14.6 \qquad \bar{\chi}_{17}^2 = 16.6 \qquad \bar{\chi}_{17}^2 = 14.5 \qquad \sigma_a = 0.918$$

The t-value of the coefficient of liquidity creation is disappointingly low. However, the cross correlation between the residuals of the above transfer function model and the (pre-whitened) $\Delta^4 \text{Lcr}$ shows a positive (but in no way significant) correlation at lag one. For that reason this transfer function is re-estimated with the $\Delta^4 \text{Lcr}$ lagged one instead of three quarters. The result is equation (HTF1) in the main text. As its fit is somewhat better, we prefer the latter transfer function.

For the external impulse we see that while the cross correlations show the largest positive value at lag 5, it is lag 6 that scores highest in the transfer function model. This lag of 6 quarters also yields the best results in the OLS regressions in section 6. As this outcome is, however, not very satisfactory, a number of alternative specifications have been estimated; the cross correlations between the residuals and the pre-whitened E series finally point in the direction of the following, be it very vague pattern: negative correlations at lags 1 and 2; positive correlations at lags 5 and 6, 9 and 10, 13 and 14 etc. With this pattern in mind, a transfer function is estimated with equation (HTF2) in the main text as the amazing result: while none of the

cross correlations come close to the boundaries of significance, all 5 parameters are significant. From an economic point of view, however, such a structure cannot be interpreted.

For the liquidity activation, the domestic money stock and public expenditure the cross correlations between the residuals and the pre-whitened series have not led to another lag structure than that identified in the first instance. This means that the various measures of the liquidity activation have been included unlagged in the transfer function models for the Holtrop equation, while $\Delta\Delta^4L$ and $\Delta\Delta^4F$ occur in the St. Louis transfer function model with a single lag of 3 and 1 quarter respectively.

pt

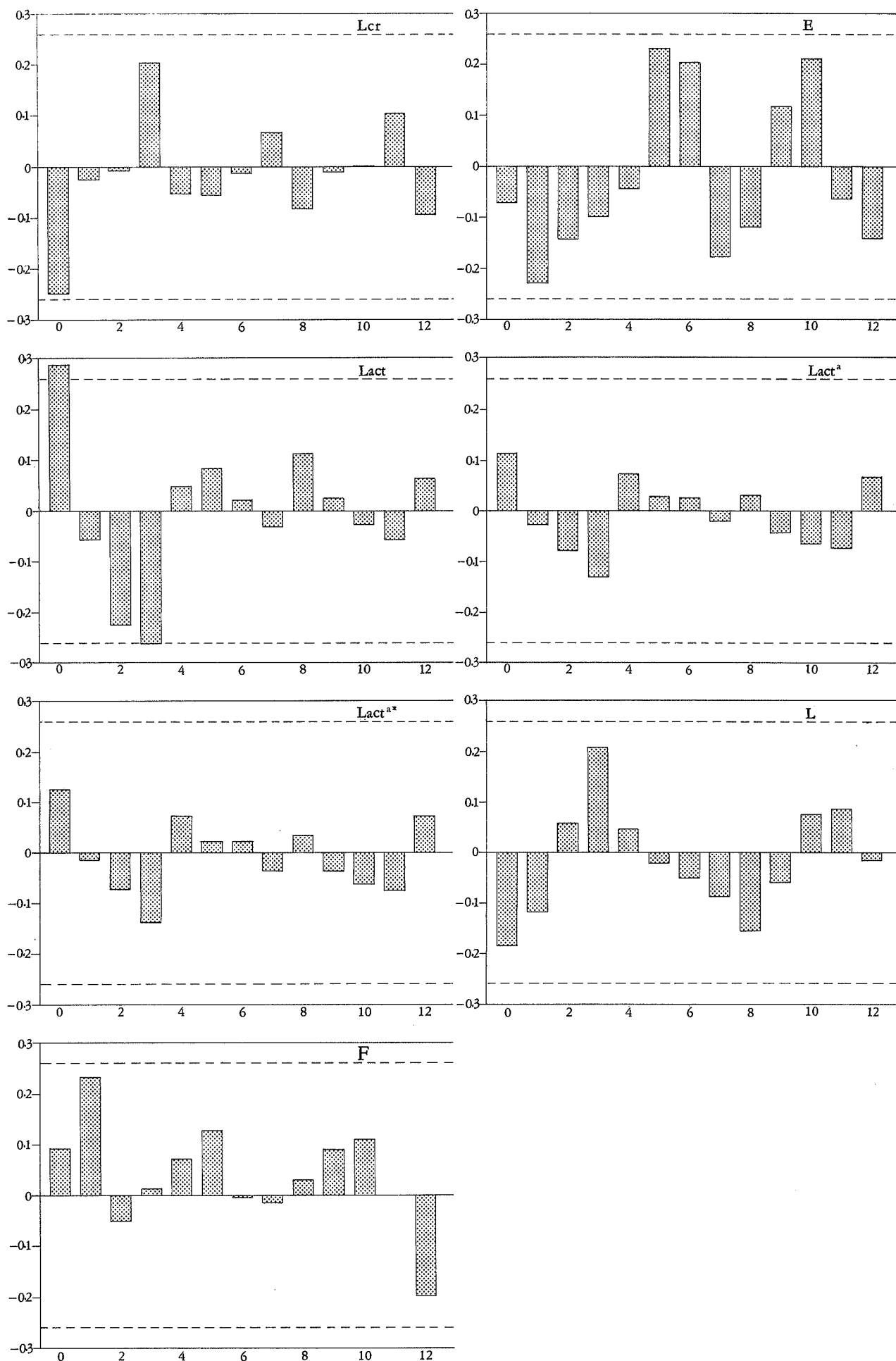
REFERENCES

- Andersen, J.C. and J.L. Jordan, 1968, "Monetary and fiscal actions: a test of their relative importance in economic stabilization", Federal Reserve Bank of St. Louis Review 50, 11-24.
- Bos, H.C., 1965, A discussion on methods of monetary analysis and norms for monetary policy (Rotterdam University Press, Rotterdam).
- Box, G.E.P. and G.M. Jenkins, 1970, Time series analysis (Holden-Day, San Francisco, CA).
- Den Butter, F.A.G. and J.B. Kuné, 1976, "De functionele vorm van de geldvraagvergelijking in Nederland, 1952 II-1971 IV", Tijdschrift voor Economie en Management 21, 169-177.
- Carlson, K.M., 1978, "Does the St. Louis equation now believe in fiscal policy?", Federal Reserve Bank of St. Louis Review 60, 13-19.
- Courakis, A.S., 1978, "Serial correlation and a Bank of England study of the demand for money: an exercise in measurement without theory", The Economic Journal 88, 537-548.
- Engering, F.A., 1972, "De monetaire multiplier en het monetaire model", Maandschrift Economie 36, 521-549.
- Fase, M.M.G., 1977, "Savings deposits, time deposits and interest rate differentials", De Nederlandsche Bank N.V. Quarterly Statistics No. 2, 78-88.
- Fase, M.M.G., 1978, "Een verdeelmodel voor liquide activa", E.S.B. 63, nr. 3144, 215-218.
- Fase, M.M.G. and J.B. Kuné, 1974, "De vraag naar liquiditeiten in Nederland, 1952-1971", De Economist 122, 326-356.
- Fase, M.M.G. and M. van Nieuwkerk, 1975, "Anticipated inflation and interest rates in an open economy: a study of the Gibson paradox for the Netherlands", in: F. Masera, A. Fazio, T. Padoa-Schioppa, eds, Econometric research in european central banks (Banca d'Italia, Rome) 297-321.

- Friedman, B.M., 1977, "Even the St. Louis model now believes in fiscal policy", *Journal of Money, Credit and Banking* 9, 365-367.
- Goedhart, C., 1955, "Monetair evenwicht in een dynamische volkshuishouding", *De Economist* 103, 161-202 en 272-312.
- Granger, C.W.J., 1969, "Investigating causal relations by econometric models and cross-spectral methods" *Econometrica* 37, 424-438.
- Guitian, M., 1977, "Dutch monetarism: a comment", *Journal of Monetary Economics* 3, 379-381.
- Hendry, D.F. and G.E. Mizon, 1978, "Serial correlation as a convenient simplification, not a nuisance: a comment on a study of the demand for money by the Bank of England", *The Economic Journal* 88, 549-563.
- Holtrop, M.W., 1972.1, "Summary of the President's address delivered at the meeting of the bank council on November 23, 1948", in: M.W. Holtrop, *Money in an open economy* (Stenfert Kroese, Leiden), 3-28.
- Holtrop, M.W., 1972.2, "The relative responsibilities of governments and central banks in controlling inflation" in: M.W. Holtrop, *Money in an open economy* (Stenfert Kroese, Leiden), 155-180.
- Holtrop, M.W., 1972.3, "On the effectiveness of monetary policy: the experience of the Netherlands in the years 1954-1969", in: M.W. Holtrop, *Money in an open economy* (Stenfert Kroese, Leiden), 221-254.
- IMF, 1977, *The monetary approach to the balance of payments* (Washington, DC).
- Johnson, H.G., 1972, *Inflation and the monetarist controversy* (North-Holland, Amsterdam).
- De Jong, F.J., 1955, "Monetair evenwicht en inkomensevenwicht", *De Economist* 103, 421-445 en 505-534.
- De Jong, F.J., 1967, *Dimensional analysis for economists* (North-Holland, Amsterdam).

- De Jong, F.J., 1973, Developments of monetary theory in the Netherlands (Rotterdam University Press, Rotterdam).
- Klant, J.J., 1966, "Monetaire filosofie en folklore", De Economist 114, 24-42.
- Kessler, G.A., 1958, Monetair evenwicht en betalingsbalansevenwicht (Stenfert Kroese, Leiden).
- Kessler, G.A., 1972, "Monetary analysis and monetary policy", in: M.W. Holtrop, Money in an open economy (Stenfert Kroese, Leiden), XXV-XLVI.
- Koopmans, J.G. 1933, "Zum Problem des "neutralen" Geldes", in: F.A. Hayek, ed, Beiträge zur Geldtheorie (Julius Springer, Wenen) 214-359.
- Kuipers, S.K. and B.S. Wilpstra, 1973, "Over Holtrops monetaire theorie", Maandschrift Economie 37, 489-511.
- Kuné, J.B., 1972, "De invloed van monetaire en budgettaire politiek op de bestedingen: de St. Louis methode toegepast op Nederland", Maandschrift Economie 37, 16-27.
- Kuné, J.B. and M. van Nieuwkerk, 1974, "De ontwikkeling van de geldquote in Nederland: 1900-1970", Maandschrift Economie 39, 1-16.
- Pierce, D.A. and L.D. Haugh, 1977, "Causality in temporal systems", Journal of Econometrics 5, 265-293.
- Polak, J.J., 1957, "Monetary analysis of income formation and payments problems", International Monetary Fund Staff Papers 6. 1-50.
- Polak, J.J. and L. Boissonneault, 1960, "Monetary analysis of income and imports and its statistical application", International Monetary Fund Staff Papers 7, 349-415.
- Rutten, F.W., 1973, "Boekbespreking van M.W. Holtrop, Over de doeltreffendheid van monetaire politiek: Nederlandse ervaringen 1954-1969", De Economist 121, 301-303.
- Selden, R.T., 1975, "A critique of Dutch monetarism", Journal of Monetary Economics 1, 221-232.
- Williams, D., 1978, "Estimating in levels or first differences: a defence of the method used for certain demand-for-money equations", The Economic Journal 88, 564-568.

Chart B1: Cross correlations



EXPLANATORY NOTE: LAGS ARE INDICATED ON THE HORIZONTAL AXIS, DOTTED LINES INDICATE 2σ LIMITS